Exercise 3.1 — The addition law

Q1 **a)** $P(A') = 1 - P(A) = 1 - 0.3 = 0.7$

b) $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
$= 0.3 + 0.5 - 0.15 = 0.65$

c) $P(A' \text{ and } B') = 1 - P(A \text{ or } B) = 1 - 0.65 = 0.35$
Remember, A' and B' is the complement of A or B.

Q2 **a)** $P(B') = 1 - P(B) = 1 - 0.44 = 0.56$

b) $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
$= (1 - 0.36) + 0.44 - 0.27 = 0.81$

c) $P(A \text{ and } B') = P(A) - P(A \text{ and } B) = 0.64 - 0.27 = 0.37$

d) $P(A \text{ or } B') = P(A) + P(B') - P(A \text{ and } B')$
$= 0.64 + 0.56 - 0.37 = 0.83$

Q3 Let B = 'car is blue' and E = 'car is an estate'.

a) $P(B') = 1 - P(B) = 1 - 0.25 = 0.75$

b) $P(B \text{ or } E) = P(B) + P(E) - P(B \text{ and } E)$
$= 0.25 + 0.15 - 0.08 = 0.32$

c) $P(B' \text{ and } E') = 1 - P(B \text{ or } E) = 1 - 0.32 = 0.68$

Q4 **a)** $P(Y') = 1 - P(Y) = 1 - 0.56 = 0.44$

b) $P(X \text{ and } Y) = P(X) + P(Y) - P(X \text{ or } Y)$
$= 0.43 + 0.56 - 0.77 = 0.22$

c) $P(X' \text{ and } Y') = 1 - P(X \text{ or } Y) = 1 - 0.77 = 0.23$

d) $P(X' \text{ or } Y') = 1 - P(X \text{ and } Y) = 1 - 0.22 = 0.78$

Q5 **a)** $P(C' \text{ and } D) = P(C') + P(D) - P(C' \text{ or } D)$
$= (1 - 0.53) + 0.44 - 0.65 = 0.26$

b) $P(C' \text{ and } D') = P(C') - P(C' \text{ and } D)$
$= 0.47 - 0.26 = 0.21$
Just as $C = C$ and $D + C$ and D',
$C' = C'$ and $D + C'$ and D'

c) $P(C' \text{ or } D') = P(C') + P(D') - P(C' \text{ and } D')$
$= 0.47 + 0.56 - 0.21 = 0.82$

d) $P(C \text{ and } D) = P(C) + P(D) - P(C \text{ or } D)$
$= P(C) + P(D) - [1 - P(C' \text{ and } D')]$
$= 0.53 + 0.44 - (1 - 0.21) = 0.18$

Q6 Let M = 'has read To Kill a Mockingbird'
and A = 'has read Animal Farm'.
Then $P(M) = 0.62$, $P(A') = 0.66$, and $P(M \text{ or } A) = 0.79$.

a) $P(M \text{ and } A) = P(M) + P(A) - P(M \text{ or } A)$
$= 0.62 + (1 - 0.66) - 0.79 = 0.17$

b) $P(M' \text{ and } A) = P(A) - P(M \text{ and } A)$
$= 0.34 - 0.17 = 0.17$

c) $P(M' \text{ and } A') = 1 - P(M \text{ or } A) = 1 - 0.79 = 0.21$